A REPORT ON
A REQUIREMENTS DEFINITION, IMPLEMENTATION PLAN AND COSTS FOR A GIS PILOT IN THE DEPARTMENT OF FISHERIES AND AQUACULTURE

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- EXECUTIVE SUMMARY -

Fulfilling the mission and mandate of the Department of Fisheries and Aquaculture involves issues whose spatial boundaries encompass far more than the geographic area of New Brunswick. The complexities of these issues has invoked a need for better use of information technologies. The department has chosen to evaluate the application of GIS (Geographic Information Systems) technology to its needs. It has further focused its evaluation on the needs specific to the Gulf herring management plan, and those of the aquaculture branch. As a first step in the evaluation process, the department has initiated a formal SRD (Systems Requirements Definition). This report details the SRD, submits an implementation plan and estimates costs.

The SRD was based on extensive interviews with the department staff. From these interviews, process models were developed to describe current and planned administrative processes where a significant amount of the process used spatially related data. Graphic and descriptive models were created that displayed the spatial information used by the department in fulfilling its mission. The future role for a GIS within the department was derived from this data and process modeling exercise.

Several key issues evolved during the study that would have an impact on the GIS pilot study. The most important and pressing issue is the development of a memorandum of understanding (MOU) on exchange of data with DFO not only for the Gulf region but also the other three administrative areas of DFO in Atlantic Canada. Without this MOU, the department will have to re-evaluate completely where its data for a GIS would come from. Another key issue, is the role the department will play with respect to environmental issues in the coastal zone. Being a relatively informed observer requires an environmental database of significantly lesser accuracy, detail and

currency than that of an active participant in policy creation and enforcement. The role of the department in this context needs to be better defined before final design of the environmental component of the GIS database can take place. The last issue of major importance is the task of resourcing the GIS pilot study. Without proper resourcing, the GIS pilot will fail. Important questions will remain unanswered, the required products undelivered and the potential use of GIS technology thwarted before it has a chance to prove itself to departmental staff. For success, a compliment of five GIS specific personnel need to be trained and additional training, ranging from 15 to 25 man days each, is needed for seven department users.

The implementation of the pilot will involve purchase of 2 Sun Sparc Sta 1 workstations with a digitizer, plotter and printer/plotter all networked. Additionally, in order to deliver some GIS capability to the regions, 2 microcomputer systems are also planned. There are 30 events planned within the pilot study. They are estimated to take 15 months to complete. The resolution of the key issues described above will have an impact on the schedule.

The total costs for the project are estimated as follows:

		MINIMUM	MAXIMUM
Hardware Purchase		132,852	141,383
Software Purchase		76,275	76,275
Maintenance -	Hardware	7,500	7,500
	Software	10,845	10,845
Training in	Caris	41,850	41,850
	Systems	8,100	8,100
Database Aquisitions		30,750	30,750
French Translation of Manuals		110,000	110,000
Human Resourcing			
	Departmental Staff	187,500	187,500
	Consultants	94,258	94,250
Physical Facilities		6,938	6,938
TOTAL 15 MONTH COSTS		$706,868	$715,391

1.0 INTRODUCTION

The Department of Fisheries and Aquaculture undertook a requirements definition study on the potential use of geographic information systems (GIS) technology for its management needs. The following report details this requirement study as well as a range of other associated issues. These issues were, the need for an M.O.U. (memorandum of understanding) with DFO (Department of Fisheries and Oceans), data sources for GIS other than DFO, the resources required by a GIS and an implementation schedule and estimated costs for phase II of this pilot study. A very lengthy appendix follows the body of the report containing documents describing current coastal mapping initiative in Canada and the US as well as examples at basic data sources needed by DFA for Phase II of the pilot.

For those new to this technology, a brief definition is in order. A geographic information system (GIS) is a computer system (hardware and programs) designed to allow users to collect, manage and analyze information that is spatially referenced. Spatially referenced means that each piece of data has with it something relating it to the real three dimensional world be it an address, a place name or a coordinate like latitude and longitude. The purpose of a GIS like any other information system, is to provide assistance in decision making. For those that would like more information, Appendix X-3 contains a brief tutorial on GIS designs and capabilities.

2.0 THE CURRENT DEPARTMENTAL SYSTEMS

In performing the requirement definition study the objective was to define the current information management systems used by the Department of Fisheries and Aquaculture and, using this as a base, define the functions a GIS system might fulfill. In order to define the existing systems, interviews were held with 24 people within the department (including Shediac and St. Andrews). Some individuals were revisited several times during the process. The interviews were structured to elicit information about geographical information usage and needs. The study investigated non GIS informational systems only to ascertain if they could be a possible data source for the GIS. No attention was paid to information systems that were for administrative management such as word processing or strictly accounting systems on the departmental IBM AS-400.

During the interviews, exhibits were collected and catalogued that described the issues discussed during the interviews. Many have been included in the appendices as well as the main body of this report. Notes of all the interviews are filed with the complete collection of exhibits. They can be viewed by anyone interested, but are not appended to this report. Because so much data is presented by figures and tables, and since these are referred to continuously throughout the report, Appendix X contains copies of all the figures and tables.

The pilot was designated to address two key areas of information management. These were the Gulf Herring Management Plan problems and those associated with administration of aquaculture sites. Initially, the aquaculture sites were just 50 finfish sites in the Bay of Fundy. However, during the life of this study, DFA became responsible for all the shellfish sites (787) as well. This altered the scope significantly. The GIS needs of the Aquaculture branch would now cover the entire coastline of New Brunswick.

Before focusing immediately on these two areas of concern, it is worthwhile to describe the Departments mandate and overall objectives. Figure 1 is copied from the department's annual report for 1988-89. Figure 2 presents the functions performed by groups within the department. A description of the missions for each branch within the department is also available in the 1988-89 annual report.

In Figures 3 and 4 we are introducing some concepts that will perhaps be new to the reader. Consequently, some more definitions are needed to clarify what is being presented.

Figure 3 is a "context diagram". It is a pictorial representation of the mission and mandate of the department. The square boxes on the periphery of the figure are "facets" of the business the department is involved in. The circles, represent the "relationship" of that "facet" to the business of the department. In both of these figures, no attempt was made to be "all inclusive'. It was not the intention of this project to analyze all the functions of the department. The figures focus on "spatially related" business (i.e. those perceived to be "GIS related").

Each "facet" (i.e. the square boxes) "hints" at what kind of data the department needs to fulfill its mission. However, more detail is needed on each "facet". Consequently, we break Figures 3 and 4 down into small bits by describing each "facet".

Figure 7 for example is a breakdown of the facet "**Plants**", (the very top one on the context diagram of Figures 3 and 4). Again, each box on the periphery depicts a piece of what describes the business of the department as it relates to plants. In this case, we identify these further breakdowns of the plants facet, as "**entities**". If we view just one entity, for example "species" in the top right corner of Figure 7, we know there is more that can be said about species. Table 1 is used to fill out more of the information know about species. Look at the fourth entry down the left side of Table 1. Now each subsequent column "fleshes out" what the department needs to know about the "entity" species. A brief description of the entity is provided. The attributes are the individual data elements that define species. The dimensions tell us how many attributes there are and how many character or numbers each attribute is in length, if possible. The data source is where it is most likely the department could acquire the data and the data type at source tells us if the data are available in reports, manual records, maps or electronic files and, perhaps, what form of electronic file.

This process of diagraming is called "data modelling". In essence, it is like drawing the data needed or currently used by the department.

One other diagramming tool is used in "sketching out" information systems. This is called a process model. Figure 6 is an example of this. Each bubble represents a step through a process, in this case the acquisition of a Plant License. Each process is numbered. The exhibits are examples collected during the interviews, for example the application for a license or the license itself. The open sided boxes labelled DS-1 etc. are data stores. These are files, either manual or electronic, that contain data related to the process.

With these two tools, the process model and data model, the current information flow needed for the department to fulfill its mission can be detailed.

Given this brief tutorial, what will follow is a description of each facet and each process where the GIS could play a role.

BUYERS

The department licenses all the fish buyers (approximately 800) that purchase fish in New Brunswick. Not all of these buyers reside in NB. These could be buyers from other provinces and countries. Acquisition of a fish buyer's license is described in Figure 5. The licenses are renewed annually. Renewals occur throughout the year at a rate of 20-40 per week with the peaks occurring in June. The system is largely manual except for an index of the buyers with their addresses maintained in a dBase III application on a micro within the inspections branch.

PLANTS

The department, under the Fish Processing and Fish Inspection Acts, has responsibility for licensing processing plants **and** fish processing. There are approximately 180 plants in NB. The process for licensing both the plants and fish processing is described in Figure 6. There is virtually no growth in the number of plants at this time. The renewal of plant licenses occurs annually on April 1. This represents a significant effort for the inspections branch at this time since the system is totally manual. A system to assist in the roll over of these licenses is being developed on the departmental IBM AS-400. As well, it is intended to gather statistical data from the plants on production by species by process. In what format the dat will be presented has not yet been determined. Until one year's response has been obtained, no judgement can be made of what processing of the production data would be required.

Because the inspection of the processing of fish in NB plants plays such a large role in the departmental mission, a model of the data used by the department in relation to plants was created. This model is portrayed in Figure 7. Tables 1 and 2 detail each attribute and the relationships between entities.

AQUACULTURE SITES

The department is also responsible for administering the Aquaculture Act. This responsibility is fulfilled by the Aquaculture Branch. Currently the branch is responsible for 50 finfish sites, 787 shellfish sites, 33 private hatcheries, 6 government hatcheries with 6 more under consideration, up to 2000 trout ponds, and has assumed responsibility for leasing of 19 lobster pounds with 12 more pound sites under consideration. Since the branch is new, a definitive process for dealing with new aquaculture leases has not been put in place. Figure 8 shows the proposed process of both leasing and licensing and a new aquaculture site. Figures 8a and 8b expand on portions of Figure 8. Figure 9 is a model of the data needed by the Aquaculture Branch to accomplish its mission. Figure 9a is an expansion of one entity, the fish growing environment, shown in Figure 9. Tables 3 and 4 detail the entities and attributes portrayed in the models. In the case of the aquaculture branch, the systems described here is in fact what the proposed system should accomplish.

VESSELS

The department allocates almost 80% of its budget to upgrading the fleet of vessels in NB. However, their control over the fleet is only partial. The Department of Fisheries and Oceans (DFO) issues fishing and vessel licenses. Consequently, the department only maintains data (on the departmental IBM AS-400) on that portion of the fleet in which it has invested public funds. This is not a complete inventory of the NB fleet.

A project was initiated with a summer student to inventory the inshore fleet. Some of this data is on the AS-400 but again, this inventory combined with data in the loan system does not comprise a complete inventory of the fleet. Departmental staff agree that the most up-to-date (within 1 year) and complete inventory of the fleet is only available from the DFO licensing system.

Figure 10 is a model of the data needed or used by the department in administering its mission with respect to the provincial fleet. Tables 5 and 6 describe the attributes of these individual entities and their relationships. Clearly, since the bulk of the data is derived from DFO sources, establishing an MOU with DFO about data access is of considerable importance to the GIS pilot. This will be expanded on in a later section.

FISH

Since DFO has exclusive control over fish stock management and quota allocations and given that DFA sees no advantage in duplicating the DFO effort, a data model concerning fish was not developed. The department's primary goals are to support measures that help the provincial fishery acquire it's fair share of the allocations of Atlantic fishstocks and to guide the orderly growth and development of the aquaculture industry. To facilitate this, significant data sources are required. All of these have been addressed in the data models presented so far. However, since this pilot is intended to meet the needs of the Gulf Herring Management Plan a process model was developed for the steps NB takes during the fish stock allocation negotiating process directed by DFO. This is shown as Figure 11 and further detailed in Table 7. Because of the large number of management plans, each with it's own set of deadlines, a chart showing these critical time deadlines was developed for all management plans. This is shown as Figure 12. Obviously, the GIS would need to provide the essential data within these specified times in order to met the department's needs.

FISH MARKETS

The department's needs for data on fish markets are quite numerous. Examples are:

Market Types and Characteristics
Market Locations and Segments
Product Required
Prices
Quantities
Transportation Methodologies
Competitors

Currently the department depends on outside sources for this data. These sources include federal and provincial departments responsible for exports as well as Canadian embassies, newsletters published commercially and Statistics Canada. Most of the data is aggregated by the departmental statisticians on an as needed basis. There is significant interest in the department on acquiring more market intelligence but this area is out of the scope of this pilot study. The GIS, should however, be aware of departmental initiatives in this regard since these data sources could be referenced by the GIS. Particular attention should be paid to the electronic information systems developing in the U.S. and Europe similar to the Info Globe concept. Information on those systems was gathered during the course of this study and delivered to the appropriate staff within the department.

3.0 WHERE WOULD A GIS FIT?

The purpose of this section is to describe the possible role of a GIS for the department, firstly within the context of the new management areas picked for the pilot, and secondly, for use throughout the whole department. The discussion will frequently refer back to the figures and tables developed during the analysis process of the current systems. The bulk of these were presented in the previous sections.

WITHIN THE PILOT PROJECT

--GULF HERRING MANAGEMENT PLAN--

The Gulf Herring Management Plan is prepared annually by DFO detailing the allocations for herring in the Gulf of Saint Lawrence. It details how much fish can be taken within certain zones, by what method and by what portions of the total fleet. The plan is produced in collaboration with the provinces fishermen and processors. Figure 11 describes the process and the department's role. Table 7 details the data sources and their uses for each step of the process.

Each year, different problems need to be addressed when developing the plan. Conditions in the fishery are rarely the same twice. Consequently, there is no fixed set of parameters redefined each year. There are groups of data that are assessed for consistency or that change such as landings relative provincial share and marketing statistics. However, economic conditions can vary the range of data assessed each year. One year questions of plant production capacity within a region may be significant while another year it may be fleet composition that requires attention.

The department's goal during the plan development process is to seek to maximize NB's share of fish stock allocation. To do this, one of the tasks is to monitor landings activity in detail by vessel, port, province and region. This demands sources of data on what historically has been the NB share and how it correlates to resource requirements to fill plant production capacity, fleet composition, employment profiles or historic and emerging markets. These analyses are not always constrained within one species (eg. herring). Analysis of trade-off scenarios among species also occurs.

When the department presents its case, firstly with industry (process 4.0) and then with DFO (process 6.0) it boils down this massive amount of data to a presentation several pages in length. The aim is to maximize the impact of the arguments with well documented information. The preponderance of the data used in developing the NB position is spatially related data. Significantly, most of the data used are from **all four regional DFO sources**. The department selectively repackages this data to buttress its case.

The department has prepared its case in the past employing the classic tools. These would be statistical analysis and presentations that can be performed using Lotus 1-2-3 and dBase III and IV in a micro computer environment. Essentially, these tools constrain the uses that can be made of the data acquired from DFO and other sources.

The type of information products the department needs would be correlations of species landings at plants in NB caught in certain zones, by vessels with home ports in New Brunswick compared to vessels from other Provinces. This data would need to be produced dynamically during the species season in order to ensure that the NB fleet catches its full allocation. This data then needs to be archived in order to prepare the case for the next season's allocation negotiations.

A GIS is designed to correlate this data and could produce products that would show graphically by zone, species caught vs species allocated by vessel/gear category. Linkages of plant data on employment levels and capacity to the information product described above is also possible. These would be for use during the allocation negotiation process. Clearly, these products would be useful in optimizing the use of the fleet and plant work hours during the season. They would also be valuable data when attempting to optimize the composition of the fleet.

To be useful these products need to be available at key times during the negotiation process. For that reason, the management plan cycle chart was prepared (see figure 12).

In summary then, to meet the informational needs of the department in negotiating the allocation for herring in the Gulf, the GIS must contain data bases of the following subject **for all 4 DFO regions from these sources**:

Subject	Source
Vessels	(see Appendix C)
Plants	(See Appendix E and DFA)
NAFO Zone Boundaries	(See Appendix G)
Statical Boundaries	(See Appendix G)
Allocation by Zone	(from DFO management plans)
Markets	(from various sources already described)
Landings	(See Appendix D)

The system must produce, prior to November of each year the data specified on Figure 11 between process 1.0 and 3.0. It must produce before January each year the modifications dictated by the events described in processes 4.0 to 7.0 of Figure 11. It must also accept data specified for process 11.0 as it is acquired from DFO, in order to dynamically track NB's success in catching its allocation.

AQUACULTURE SITES

The Aquaculture Branch, as mentioned earlier, is just now establishing procedures to license, lease and monitor aquaculture sites. Figure 8 describes the proposed licensing/leasing system for new sites. Figure 8 and 8b further detail processes within the proposed system. In Figure 8b, processes 3.7 and 3.9, describe the process needed when evaluating a new lease site. These two processes hint at what functions a GIS must fulfill. However, the information is not specific enough.

During interviews with branch staff, the question was asked, whether or not the branch saw a need to respond to their legislated mandate proactively or reactively. Proactively in this case, implied that they would actively search for the best sites for aquaculture in New Brunswick. Reactively implied that they would let the industry find these optimum-sites and just re-evaluate the information supplied by the applicant for a new site for accuracy and compliance with the Act. They decided the response should be reactive.

This decision meant that they would only need data for where an applicant applied for a site Consequently, a data base describing the entire N.B. coastal zone in detail would not be necessary. Some reference information would be needed to verify depth, tide, current, wave, weather data submitted by the applicant but this would not demand a complete GIS.

However, when addressing the issues related to the branch's environmental responsibilities, significant data requirements emerged. Figure 9 describes the data model for the aquaculture branch. Figure 9a details one facet only, the fish growing environment. Tables 3 and 4 detail the entities within these facets and their associated attributes. A review of these figures and their tables reveals a **significant need for a GIS**.

At a meeting of the Aquaculture Environmental Coordinating Committee at St. Andrews on December 12, 1988, the question was asked, as to what environmental issues the committee would need to address over the next eighteen (18) months. What data would they need to resolve these issues? What quality would they need in the data and where would they get the data? This was followed by a questionnaire mailed to each member of the committee (11 members). Four members responded. The data shown in Table 4 reflect the responses to the questionnaire.

This committee has been struck to deal with aquaculture sites in the Bay of Fundy. The responses to the questionnaires then, are biased towards the environmental needs of fin fish sites. However, the detail in Table 3 and 4 applies to the branch's needs with respect to finfish and shellfish sites, trout ponds and hatcheries.

GIS NEEDS - WITHIN THE REST OF THE DEPARTMENT -

During the interviews, it became apparent that several missions accomplished by the department could be aided significantly by access to the GIS. These departmental needs, when analyzed individually were not large enough or performed frequently enough to justify the expenditure on a GIS. However, collectively;, they could represent a significant use of a GIS.

The Fisheries Development Board is responsible for evaluating requests for financial assistance from vessel owners and aquaculturists. Questions arise that the board cannot easily answer. These questions pertain to the appropriateness of the planned vessel for a particular area and for a particular species or group of species. To be able to verify that a vessel of a certain type, fishing in a certain region for those species will indeed earn enough revenue based on current allocations to pay back the loan, would be of considerable use to the loan board staff. Historic performance of that applicant would also be useful. With access to a suite of data acquired from DFO through an MOU, and embedded in the GIS for use in management plan negotiations, the board could address those issues.

Figure 12 describes times during the year when key pieces of data are needed during the allocation negotiation stage for all species. The GIS needs described with respect to herring in the Gulf can be applied to all species for all regions.

In the summer of 1989, the department was evaluating a proposal to develop an expert systems for fleet optimization purposes. The basic need of such a program is a complete data base on the existing fleet. It also requires knowledge on catches by vessel and gear. Again any information acquired from DFO under the MOU would be part of the information needed for this project.

4.0 DATA SOURCES FOR THE GIS

The GIS pilot must develop a significant database before it can deliver the information products and services described in the preceding section. Not all of the data are currently available in electronic form. Tables 2, 3, 4, 5 detail what data are needed as well as sources for the data and the nature (ie. electronic or hard copy) of the data at that source. Appendices C, I, J, O, P, W and X provide examples of some of the basic data needed as well as indexes to that data.

GIS databases are generally broken down into two categories, base mapping and thematic overlays. Base mapping depicts features typically found on any map, such as, roads, railroads, rivers, places, political boundaries, and topography. The thematic layouts depict specialized data like plant locations, and landing by zones. For the department, the base mapping presents some interesting problems. Typically, a GIS operates in one domain like land or water but not both. The departments mandate is in both domains hence the need for base mapping in both. Land based mapping is done quite differently than ocean mapping. Where the two types join can often create duplication and uncertainty, both of which are **not desirable** in a database.

Appendix H contains a report on coastal mapping prepared by GIMAC (Geomatics Information Management Advisory Committee). It details investigations made for this committee on issues related to mapping in New Brunswick coastal waters. It does not answer the problems this pilot study will encounter. The steps proposed in that report should contribute to resolving those difficulties, however.

The base mapping needs for the department vary. For land based information needed in negotiating management plans the existing 1:500 000 provincial map from EM & R in Ottawa provides sufficient detail. It would need to be digitized. However, the Aquaculture Branch has needs that will require base mapping at much larger scales. The branch has determined that base mapping at scales of 1:20 000 would meet their need. There are no 1:20 000 base maps that cover all of N.B.'s coastal waters. MRMS produced nineteen 1:20 000 maps for the south west corner of New Brunswick. That area was covered by 54 maps of 1:10 000. The 1:10 000 data are acquired from existing digital files in CARIS that were converted to DLG format and transferred to GEOMATE. These files could be available to the pilot but may not be useful.

There are 222 map sheets at 1:10 000 scale that cover New Brunswick's coastline. Not all these sheets are available in digital form. There are 67 sheets from Campbellton to Newcastle that are only available in paper form. Consequently, base mapping for the aquaculture branch will require acquisition of about 155 digital map files and 67 hardcopy maps. The digital files would need to be recreated at 1:20 000 which would yield about 39 digital map files. The 67 hardcopy maps would need to be digitized and then recompiled at 1:20 000 producing about 17 map files.

Both of the above series, the Federal EMR 1:250 000 and the LRIS 1:20 000, will only define the land side of the coastal mapping. To define the ocean side, charts and worksheets from the Canadian Hydrographic Service (CHS) will have to be digitized since none are available in digital form. Appendices O, P, and X-2 show the extent of coverage available from those sources.

For management plans and other general purposes the following CHS charts would be required:

CHART NUMBER
4000
INT 404/4001
4006
407
401
4003
4012
4011
4010
4023
4024
4002

For the aquaculture sites, the worksheets shown on Figure 13 would need to be digitized to cover all the existing fin fish sites. For the existing 787 shellfish sites the CHS worksheets shown on Figures 14 and 15 would need to be digitized. The shellfish sites are dispersed along the entire eastern shore.

All the sources described so far would be able to provide the base mapping source documents. The thematic data will come from other sources. Many at those sources have been described in Tables 1, 3, 4 and 5. However, it would be useful to describe some of the larger sources of thematic data.

The DFO in Moncton has used a CARIS system for the last several years. It was acquired primarily to deal with shellfish leases and a contamination problem with mussels. DFO has digital files on approximately 80% of the 787 shellfish leases and has stated that it will provide DFA with that data. Consequently, only the missing leases need to be digitized. Additionally, the small craft harbours group has created digital files of all the small craft harbours for which it is responsible in New Brunswick. These would be in the Northeast and Southeast portions of New Brunswick. They will also provide this data to DFA. Appendix X-4 contains DFO documentation on their symbols and symbol codes, as well as, symbology used by the CHS.

DFO in Moncton also has a large Hewlett-Packard 3000 installation. Appendix B describes this computer facility and the application systems running at that site. Appendices C, D, and E contain extracts of the data dictionaries for all of these systems. These appendicies reflect the data available for the gulf environment that DFA must acquire for it's GIS pilot. For the other three regions, Scotia Fundy, Quebec and Newfoundland, equivalent systems are in place. The data dictionaries have not been acquired from those regions yet. The MOU must be established with the Gulf Region first. However, data equivalent to that shown in Appendices C, D, and E must be acquired from those regions as well for the GIS Pilot.

The DFA has an inventory of plants and buyers already in a dBase III file. This data can be useful in the GIS. Using a gazetteer function embedded in the N.B. Maps system (Appendix X-2) these place names can be given latitude and longitude or N.B. stereographic x and y coordinates. This would facilitate conversion of dBase III files to an INGRES file (i.e. the relational data base used in CARIS) and to CARIS itself.

Similarly, the Department of Commerce and Technology maintains electronic files of marine and other industrial services available in New Brunswick. Again, using the gazetteer functions embedded in N.B. MAPS (Appendix X-Z), some of this data can be given a geographic reference that would make the data useful for the GIS.

The data sources needed for the aquaculture branch are primarily federal. It has been recommended that instead of acquiring all the meterological data through MEDS (Marine environmental data service), which is expensive, the pilot team should search for the data from other sources first, like BIO (Bedford Institute of Oceanography), or Department of Environment. In so far as weather data are concerned, there are 7 sites in New Brunswick along the coast for which data can be acquired in electronic form from AES (Atmospheric Environmental Service) locally. These are as follows:

• CHARLO	X
• BATHURST	
• MISCOU	
• CHATHAM	X
• MONCTON	X
• SAINT JOHN	X
• GRAND MANAN	
• CAPE TORMENTINE	X

Temperature, and precipitation data for the last 10 years on diskette are available for each of these sites. Wind speed and wind direction for only those marked with an X. Tide data in electronic form should be available at BIO for the 5 permanent tidal stations in New Brunswick. These are as follows:

- DALHOUSIE
- MISCOU
- ESCOUMINAC
- POINT DU CHENE
- SAINT JOHN

For data on the wave regime, it seems that it may make more sense to purchase the software to perform wave hindcasting from the AES weather data and the bottom topography and coastline data already part of the GIS database. Eastern Designers Ltd. of Fredericton have a software set developed in Fortran in an IBM PS/2 environment. It may be possible to embed this modeling tool within the GIS in lieu of trying to develop a meaningful wave regime data base for the entire coastline of New Brunswick. This philosophy should also be followed when modeling the dispersal of contaminants and trajectory of algae blooms.

Appendix J contains index and legend data for a coastal mapping projects done by Hunter and Associates for the Department of Natural Resources and Energy in 1980 and Airphoto Analysis Associates Consultants Ltd. in 1975. The source documents are all based on photomosaics. While the map base itself is inadequate for use in a GIS, the inventory data are useful. There are 74 maps in the survey covering the entire Fundy coastline in New Brunswick. The inventory delineated seven land use categories, 27 vegetation classes and 70 land management classes. Eight of these were fisheries specific. Much of this data would need to be manually transferred to orthophoto maps first and then digitized from that geometrically correct source. There are 49 maps for the NE and SE regions but with slightly less detail. The purpose of the 1975 survey was different from the 1980 survey.

DFO in Moncton has mapped the N.E. from Miscou to Newcastle for shellfish habitats. The project was done in an Auto Cad environment. The NTS 1:50 000 series was used for the based but was presented in 1:10 000. The habitat data added to the base map included bottom type, vegetation and a rough approximation of species distribution based on visual surveys. These files are all in DFX format and could be transferred to CARIS. It may however be more practical to transfer the habitat data only.

5.0 THE MOU WITH DFO AND ITS IMPORTANCE

Several times in the preceding two sections, mention has been made of a MOU with DFO on data sharing. For the GIS pilot, data sharing is crucial. DFA has very little of the data it needs for a meaningful GIS pilot. Additionally not all the data reside in DFO Moncton. Information from the other three DFO regions in Atlantic Canada is needed as well as data from AES, BIO, MEPS, etc.

The discussions on a MOU have already begun. On November 2, 1989, meetings were held between DFA and DFO staff in Moncton on technical issues. These were followed up by phone calls and finally the delivery of the DFO data dictionary to the consultant. The dictionary was reviewed and selection of the data elements DFA needed was completed. Documentation detailing the needed data elements were given to Ron Sisk to deliver to DFO in Moncton. Another meeting with DFO was held January 29, 1990 in Moncton. At this time, DFO explained that any files that contained a person or vessel owner or plant owner personnal data such as his address or name would require his written permission for DFO to release that data to Department of Fisheries and Aquaculture. Of the 28 files DFA would like access to, only 12 can be delivered immediately. Sixteen files contain personnal data. The files that would require permission are those detailing the fleet, licenses holder, catches, plant and plant production. In short, the most important data sets for a meaningful pilot project.

Before data can be acquired for the Gulf region this MOU must be established. Until data sharing is established with the Gulf Region, negotiations cannot begin with the other 3 regions. Data are needed for the pilot from all 4 regions.

6.0 THE ROLE OF GEOMATE

Over the last several years MRMS(Maritime Resource Management Service) in Amherst, Nova Scotia, has been involved in cooperative research projects with DFA and DNRE. As mentioned in Section 4.0, DNRE commissioned MRMS to produce the nineteen 1:20 000 coastal maps for Southwest New Brunswick. Additionally, MRMS developed digital files on finfish aquaculture sites in SW New Brunswick. These files were based on digitized data from aerial photos. MRMS developed the application primarily as a demonstration of what GEOMATE, as a tool, could do for DFA.

The Study Team has acquired a copy of GEOMATE software and the user documentation. While not specifically part of this study, the team had hoped to be able to load the software and to evaluate the system for DFA use. The team have been unable to do so due to resource constraints (i.e. people, time and equipment) .

Discussions with Aquaculture Branch personnel familiar with the GEOMATE project have revealed that the database constructed within GEOMATE is not accurate or complete. Consequently, the GIS pilot should not consider trying to include either the GEOMATE product or its DFA database.

7.0 LANGUAGE REQUIREMENTS OF THE GIS

The Department of Fisheries and Aquaculture needs a GIS that can be used by staff in either official language. This requires that system documentation, user documentation, all screens and all output be available in either language. This would also include the INGRES documentation.

At this time, not all those linguistic capabilities exist within the CARIS environment. Table 15 details the French availability of systems and user documentation as well as the product capability of all the associated pieces that comprise CARIS. Universal Systems Ltd. has informed the consultant that it has no plans at this time to produce a bilingual product.

An alternate may be to translate the documentation for CARIS only. Translating the screens (user interface) would take place later.

8.0 REGIONAL REQUIREMENTS FOR A GIS

During the interview process in the regional offices, Department of Fisheries and Aquaculture staff emphasized their need for access to the GIS and particularly to the databases to be embedded in it. Some headquarters staff in Fredericton echoed these sentiments particularly for the aquaculture side. These needs were difficult to define accurately in terms of frequency of access requirements to the databases and for production of what products. Apparently, the departmental plan is to provide the regional offices access to the AS-400 this year. For many of the stated needs this might be all that is required. For example, the loans officer in Shediac would like access to data in the loans system. This would meet many of his needs. However, the fleet data in the loan system does not include the entire N.B. fleet. For some analysis, access to a complete inventory of the fleet, as is planned for the GIS would be useful. A licensing system for both plants and aquaculture sites is being planned for the AS-400. Again, access to this data might meet most of the regional requirements.

To establish a network to support the GIS poses some technical problems that are far more difficult to solve than for the AS-400 system. The volume of data that would need to be exchanged in a GIS is significantly more than is typically exchanged from the loan system, for example. Transmission speeds of 2400 bits per second via a dial up facility, while not invoking long delays within the AS-400, would invoke extremely long delays for the GIS. A map file in a GIS can easily be two megabytes. At 2400 bits per second transmission speed, a file that size could take two hours to send. Even at the higher speed planned with the new provincial network (9600 baud) it would take 40 minutes. (See Appendices K and L for the data on the Provincial Computer Network).

With a dedicated line, specialized software and hardware speeds can be increased to 56,000 bits per second. A file this size would then take ten minutes. However, the costs for this dedicated line alone would be approximately $1000 per month. Service to Shediac would be possible but not to St. Stephen. Beyond speed and costs there are problems associated with maintaining database integrity. The Landnet II report contains a very lucid description of these difficulties and is included as Appendix M.

One option would be to have equivalent GIS facilities in each regional office without a network. Database maintenance would be the responsibility of Fredericton. Each region would get a 'snap shot" of the database at convenient intervals. Given the costs associated with a full GIS, this is probably prohibitively expensive. An alternative may be to provide a reduced capability in GIS at the regions based on a microcomputer version of a GIS. There are several systems available that could meet the requirements. IRMIS developed by the Ocean Mining Divison of EMR is an example. The data base building would be done by the CARIS site and "snap shots" delivered by the micro GIS systems to use in a playback or query mode only. The pilot should pursue this later option in both the Shediac and St. Stephen regional offices.

9.0 RESOURCES NEEDED FOR A G.I.S.

As with any information system, particular skills are needed by the people managing the system if it is to be successful in meeting the demands placed on it. To have a sucessful, fully capable GIS unit, the department will need people who can perform NINE general functions. It is possible that a person can successfully perform more than one function. The controlling factor is usually how large and utilized a GIS system will be. The nine functions needed are as follows:

1. **MANAGER**

   Has a broad general knowledge of the GIS applications, capabilities, and data base requirements of the organization. He/she is experienced in personnel management is skillful at keeping the staff motivated, loyal and working at capacity. He/she leads coordination with the user community and is well respected by users. He/she knows how to estimate resources and costs and he how to get money and commitment to support the facility.

2. **G.I.S. ANALYST**

   Has specific knowledge of the G.I.S. and its use. He/she can design data bases as well as analytical procedures required for their users' applications. He/she is a strong communicator who can listen to user requests and translate them into methods and procedures for generating G.I.S. products. He/she knows how to plan productions steps for G.I.S. applications. He/she gets the products done and delivers to users and he/she takes useful feedback from the user. He/she has their confidence and he/she is their educator about G.I.S.

3. **DATABASE MANAGER**

Has a knowledge of G.I.S. data base design and experience with data use in G.I.S. applications pertinent to the organization. He/she knows and understands mapping principals as well as more traditional data base design principles. He/she organizes data sets into layers and descriptive fields, chooses the data sources, levels of resolution, coordinate systems, and mapping procedures to be used. He/she knows how to design attribute data bases and associate this descriptive data with map features. He/she knows how to develop and manage automated map libraries and data dictionaries and can ensure quality control. He/she directs all data automation and maintenance.

4. **SENIOR PROCESSOR**

Has a knowledge of using the G.I.S. to produce products outlined and specified by the G.I.S. Analyst. He/she knows how to use the software, hardware, and data to generate products. He/she designs day-to-day product generation tasks. He/she either designs processes or follows those already outlined by the G.I.S. analysts to build a product. He/she manages simple computer tasks performed by lower level processors. He/she follows a process - a set of steps to generate products.

5. **CARTOGRAPHER**

Has experience and working knowledge of map drafting/cartographic principles. He/she provides support at two critical phases of G.I.S. operation; 1) data entry and 2) map display. For data entry, he/she compiles and integrates map data from many sources for automation, including existing maps, aerial maps to be produced by the system. The cartographer provides help in using and producing high quality graphic data.

6. **DIGITIZER/KEY OPERATOR**

Has experience in general G.I.S. operation and/or key entry. He/she has responsibility for data entry operations - digitizing, map editing, and key entry of descriptive data. He/she pays a lot of attention to detail. He/she likes to work on well-defined tasks which have a definite beginning and ending, and they can concentrate on those tasks. He/she actually creates the data base under the direction of the Senior Processor.

7. **COMPUTER SYSTEMS ADMINISTRATOR**

Has knowledge and experience in maintaining a computer system, including all hardware, software, peripherals, and supplies. He/she keeps the facility going.

8. **PROGRAMMER**

Has experience with using G.I.S. systems and is proficient at programming with FORTRAN, COBOL, or similar languages. He/she is the developer of site-specific application software which meets very specific needs - such as development of special data conversion programs. It may also develop and maintain user MACROS to allow system access to less experienced users. In this way, he/she brings the system closer to the end user.

9. **END USER (aka the Users)**

Have a general knowledge of the functions and capabilities of G.I.S. and how G.I.S. can be applied to meet their needs. He/she makes request of the G.I.S. facility to produce a specific set of well-defined products which are of utility to the decision maker. He/she has a basic knowledge of system capabilities and of the resource requirements (time, people) which are required to produce typical products. Users or the users' boss provides support and funding for the G.I.S. organization. User needs are the needs which the G.I.S. must address. Users are the ones to be kept happy. They are also the ones who typically require a lot of education. The more sophisticated the users the greater the benefits that can be derived from a GIS system.

Functions 2, 3 and 4 can be combined in one person if that resource has the skills. This is also true for Functions 5 and 6. To some degree, Function 7 already exists within the department. After the first year or so function 8 could be hired as a consultant on an as needed basis. This would reduce the first eight functions to five key resources (without inclusion of the users) that are not skills currently available within the department. If current staff are to be used, substantial amounts of training will be required for these functions, as well as for the users. If the resourcing is to be done by hiring trained people, then the search for such staff should begin immediately. Skilled GIS resources are a very scarce commodity these days.

If resourcing is to be done by retraining existing staff then the training matrix (Fig. 14) would outline the basic training needed by each position including seven users. The amount of training required for each element (i.e. UNIX or NFS) would vary for each position. For example, the manager does not need the depth of training in UNIX that the system administrator would.

It must be reiterated that **without proper staffing the pilot will not be successful**. It should also be recognized that part of the objective of the pilot is to train people in the technology. That is part of the technology transfrer process. If all the positions described above were filled by hired consultants merely for the purpose of the pilot, the department would not have any of the essential expertise left at the end of the pilot process. Nor is it possible to transfer these skills in a short period of time at the end of the pilot. As the training MATRIX shows, the learning curve in GIS is steep and long.

10.0 THE PROPOSED GIS PILOT/PHASE II

The purpose of this pilot project should be to guide the introduction of a full GIS to the department. As such, it should not be considered a "throw-away" experiment. Additionally, it must address all the issues related to a future full implementation of the technology. This means it must address concerns beyond those strictly related to the Gulf Herring Management or aquaculture. Those that are specific to these two areas will be described first.

The requirements for a GIS for the Gulf Herring Management Plan and for administering aquaculture sites has been described in Section 3 of this report. However, it would be worth restating here, before defining the hardware and software needed to fulfill the requirements.

The specific information products that need to be developed are:

- A document that spatially correlates landings of herring by vessels whose home ports are in New Brunswick, by where they were landed and from which zone they were caught and what the New Brunswick allocation was for that zone.
- This document must be updated throughout the herring season.
- This data must be archived for use in subsequent year's allocation negotiations.
- This data must be spatially correlated to historic fishing activity by regions in New Brunswick, including plant utilization and employment.
- Documents must be produced that detail all aquaculture sites in New Brunswick. This includes all finfish and shellfish sites (850) and all hatcheries (approximately 50). The 2000 trout ponds could be added later. The data needed per site have been detailed in Figures 9 and 9a and Tables 3 and 4.

- An environmental database that will allow correlation of aquaculture sites and their impact on the environment.
- This database must also detail known and anticipated environment hazards to aquaculture sites both natural and man made.

To produce these products, data needs to be gathered and embedded in the database of the GIS. The data that need to be acquired are as follows:

- an inventory of the New Brunswick herring fleet and its location.
- an inventory of all plants, their locations, capacity and workforce.
- an inventory of all buyers and their location
- the boundaries of all zones and statistical districts
- an inventory of all aquaculture sites, their location and capacity
- an inventory of all environmental hazards to aquaculture sites.
- an inventory of all environmental impacts of aquaculture sites.

The data models have been fully detailed in the figures and tables in Appendix X-1.

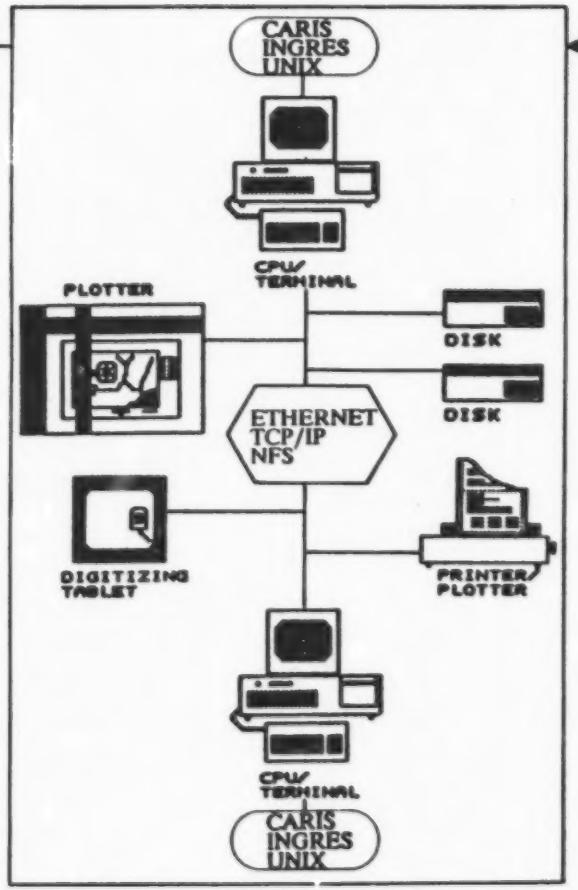
The software tool the Province has chosen as its GIS standard is CARIS developed by Universal Systems Ltd. The most recent version of CARIS (version 4.0) operates in the UNIX environment. Based on consultations with Universal Systems Ltd. the following hardware and software is required to build the database and to produce the information products needed.

D.F. & A.
GIS/CARIS PILOT

TYPICAL DATA PRODUCTS

- Historic Landings Against Quota by:
  - Zone
  - Vessel
    by Home Port
- Current Landings Against Quota by:
  - Zone
  - Vessel
    by Home Port
- Plant Utilization by:
  Landings From Zone From Vessels
  by Home Port
- Plant Employment
  From Landings By Vessels
  by Species
- Shellfish & FinFish Site
  Inventory and Evaluation
- New Aquaculture Site
  Impact on Environment
- Environment Impacts
  On Aquaculture Sites

HARDWARE/SOFTWARE NETWORK



REQUIRED DATA BASES

- EMR
  1:250 000
  DIGITAL BASE
  - SHELL FISH
    LEASE
    SITE
- LRIS
  1:10 000
  DIGITAL BASE
  - FIN FISH
    LEASE
    SITE DATA
- CHS
  BATHYMETRIC
  WORK SHEETS
  - FISH
    MARKET
    DATA
- NAFO/DFO
  ZONE
  BOUNDARIES
  - WEATHER
    DATA
- FLEET
  INVENTORY
  - WAVE
    DATA
- PROCESSING
  PLANT
  INVENTORY
  - POINT &
    NON POINT
    POLLUTION
    SOURCE DATA
- SMALL CRAFT
  HARBOURS
  INVENTORY
  - SPECIES
    MANAGEMENT
    PLANS
- FISH
  BUYERS
  - PREDATOR
    DATA

HARDWARE

2 SPARC STA 1 with 19" color monitor
with: 16 Mbytes memory
104 Mbyte internal disc
327 Mbytes external storage
1/4" tape backup

1 HP 7595A Draftmaster I plotter

1 GENTIAN digitizer, back lighted with active digitizing area of 30" X 40" minumum with pedestal stand, or equivalent

1 HP Paintjet color Inkjet printer or equivalent

ETHERNET (with cabling and connectors)

1 Digitizer Controller interfaced to CARIS v. 4.0

SOFTWARE

SUN O/S

NSF

TCP/IP

CARIS v. 4.0 Consisting of:
Basic Software plus
Reformat for: DXF
DLG
MACDIF or DX90
Raster
Postscript
Programing interface
Continuous Database Analysis

and INGRES

The pilot must also meet the needs of the regional offices. As described in Section 8.0 a reduced capability GIS is suggested for use in the regions. Tentatively, the hardware should be as follows:

1 386 Microcomputer 20 MHZ
- 19" color monior
- 1 Mbyte of memory
- 80 Mbyte disc

1 HP plotter, Draft PRO

1 digitizer, SUMMAGRID II

1 printer, dot matrix wide carriage

This hardware configuration should suffice but may be altered slightly depending on the GIS software selected.

In addition to servicing the regions, the department must establish long term data exchange relationships with at least four other computer systems. They must communicate with their own AS-400, the Department of Commerce and Technologies IBM S-36 for marine products and services data, the DFO HP3000's in all four regions in Atlantic Canada and the HP 3000 in the Department of Labour. While it would be beyond the scope of a pilot to develop RDBI's (relational data base interfaces) to each of these 4 computer systems, at the very least, the pilot must detail the magnitude of the issues involved, both technical and organizational.

The pilot must also define the efforts needed to provide CARIS and the microbased GIS according to the linguistic needs of the department.

11.0 IMPLEMENTATION SCHEDULE FOR PHASE II

The purpose of this section is to detail how long it will take for the GIS pilot to produce timely meaningful information products for the department. In preparing the implementation schedule, four key issues emerged that could have a significant impact on the project. Some of these had been touched on before within the report. However, each needs a clear explanation again in order for readers to understand their potential impact on the schedule.

- FOUR KEY ISSUES -

1. **The departments environmental management responsibilities in the coastal zone -** During the course of this requirements definition, repeated efforts have been made at acquiring a complete definition of the departments responsibility for environmental monitoring in the coastal zone and what data the department needed to meet those responsibilities. A partial definition was extracted from the aquaculture branch. None could be extracted for the remainder of the department. The data modeling is all predicated on the needs of the aquaculture branch. Any change in the departments position could alter significantly what environmental data would be needed by the GIS pilot to respond to environmental issues. Additionally, acquiring complete coverage of environmental data in the coastal zone is complicated by the multiple jurisdictions in the zone. There is no single source for the data and even worse, no complete indexes. Consequently, the estimates for building the environmental data bases (e.g. point and non point pollution sources, predators, conflicting land and water uses etc.) have the largest potential for error.

2. **The MOU with DFO -**

The GIS pilot must respond with information products for the management plan negotiating teams as specified in the Management Plan cycles chart (figure 12). If these products are not delivered on time, they are useless. In order for the GIS to produce these products, data from all four DFO regions is required. Consequently, a MOU must be in place with all these regions and the required permissions in place from individuals and plants early enough for the GIS to prepare the data. If the GIS pilot is to deliver these products for the negotiations coming up next fall, the data must be available by no later than this summer. This means the MOU's and associated permissions must be accomplished this spring.

3. **The approach to aquaculture site selection -**

The data modeling for the aquaculture branch was predicated on the branch responding to applications for site licenses from prospective site operators. This dictated that the operator would assume responsibility for picking the optimum site and the branch personnel would access the data. The branch currently is considering a tendering process for letting new sites. If the department assumes the responsibility for optimum site selection, it would demand a database with different data density, currency and quality parameters. Again, the estimates for creation of the database (particularly the environmental portions) could be changed significantly if the department changes its current approach.

4. **Base mapping -**

Fundamental to building a GIS in the coastal zone is base mapping for the coastal zone. Currently, none exists. A merger of LRIS land mapping at 1:10 000 with CHS chart and worksheet data is proposed for this pilot. There is a mapping sub-committee within GIMAC. They have been discussing coastal mapping with nothing conclusive yet. Additionally, the existing 1:10 000 digital mapping is not complete. Best estimates are that the needed sheets (67 approximately) to complete the N.B. coastline will be completed by December 1991. Consequently, this pilot is scheduled to wait for the LRIS products for the North Shore area before completing the coastal base maps for this GIS pilot. It would not be practical for the pilot to digitize the last 67 sheets and only use them for one year before the standard LRIS product would be available.

With these four issues in mind, the proposed implementation schedule is as shown in the table following this page. There are 30 key events defined. The duration of the plot is anticipated to be fifteen months. Factors that will negatively impact this schedule are as follows:

- delays in developing the MOU with the four DFO regions from whom key databases are to be acquired
- inadequate or untimely staffing of the project.
- delays in initiating the project such that provision of information products/needed to negotiate Gulf Herring Allocations are not possible within time frames allowed.

It is essential that the project manager develop process models for each event shown in the table in order to have the tools in place to reasonably mange the pilot. These process models should be created before the pilot starts.

PROPOSED IMPLEMENTATION PLAN

EVENT \ MONTHS	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
NEGOTIATE MOU WITH GULF	•								•						
NEGOTIATE MOU WITH S/F	•														
AQUIRE PERMISSIONS FOR DFO	•														
NEGOTIATE MOU WITH NFLD; PQ		•													
ORDER HARDWARE	•														
INSTALL SYSTEM		•													
TRAIN STAFF	•	•	•	•	•	•	•	•	•	•					
ACQUIRE 1:10 000 BASE MAPPING & LOAD INTO GIS			•	•	•										
DIGITIZE 1:500 000 PROVINCIAL MAP			•												
DIGITIZE CHS CHARTS				•											
LOAD DF & A PLANTS DATA				•											
LOAD DF & A BUYERS DATA				•											
LOAD NAFO & STATS BOUNDARIES					•										
LOAD DFO ANNUAL DATA FOR GULF					•										
LOAD DFO ANNUAL DATA FOR S/F						•									
LOAD C & T MARINE DATA						•									
LOAD HERRING MANAGEMENT PLAN						•									
PREPARE HERRING NEGOTIATION DOCUMENTS					•	•	•	•							
LOAD FIN FISH LEASE SITE DATA								•							
LOAD DFO CATCH & EFFORT DATA								•	•	•	•	•			
DIGITIZE HUNTER S/F SURVEY									•	•					
LOAD AES WEATHER DATA											•				
LOAD SMALL CRAFT HARBOUR DATA												•			
LOAD SHELL FISH LEASE DATA												•			
INSTALL REGIONAL MICROS													•		
TRAIN ON MICROS													•		
DOWNLOAD FROM CARIS TO MICROS														•	
LOAD TIDAL DATA IN CARIS													•		
INVESTIGATE USE OF WAVE HINDCAST, SUPERCHILL ALGAE BLOOM MODELING														•	
FINAL REPORT															•

12.0 PROJECTED COSTS FOR THE PILOT

The costs for the pilot can be grouped into the following categories as follows:

Hardware
Software
Training
Data Base Acquisitions
French Translation
Human Resources
Physical Facilities

- Hardware Costs -

Letters requesting quotes were sent to two vendors in Fredericton that are authorized to sell SUN Workstations and associated peripherals. These vendors are UNIVERSAL SYSTEMS LTD. the developer of the CARIS software and CAD/CAM Systems Ltd. The letters addressed to these agencies and their responses are included in Appendix X-6. The results are summarized as follows:

WORKSTATIONS	VENDORS	
	CAD/CAM	USL
SPARC station 1 with 19" color monitor	$26600	$26600
104 Mbyte internal hard disk	5750	5750
8 Mbyte Memory Upgrade	10100	10100
327 Mbyte external hard disc and 150 Mbyte Tape Backup	325	325
SUN O/S including TCP/IP & NFS	585	N/Q
Full O/S documentation	43360	42775
Less Discount	4336	
TOTAL	39024	42775
NOTE: NQ=NOT QUOTED		
Price for 2 units	$78048	$85550

	VENDORS	
Digitizers	**CAD/CAM**	**USL**
Summagraphics		
MicroGrid II 30" X 48"		
Backlighted	8795	
16 Buton-High Accuracy Cursor	995	
Manual lift pedestal	975	
TOTAL	10765	
Gentian digitizer		8778
power pedestal		
CARIS Digitizer Controller	6500(NQ)	6500
Plotter		
HP Draftmaster SX		12300
HP 7595-B Draftmaster SX	9634	
Printer/Plotter		
HP PaintJet InkJet		
Printer (HP 3630A)	1595	
HP PaintJet		1925
HP InkJet XL		3500
Ethernet	850 N/Q	850
Hardware Maintenance (Annual)		
On Workstations (only)	6000	5040
Micro Systems		
Everex AGI -3000D		
386-20 MHZ		
1 MByte RAM		
1.44 MB 3.5" Floppy		
80 MB Hard Disc		
Dos V3.3 or 4.01		
2 serial, 1 parallel port		
101 Key Keyboard		
8387-20 Math Copressor	4595	N/Q
14" Monochrome		
Monitor, with card	350	N/Q
14" Color Monitor	1295	N/Q
HP InkJet Printer	1595	N/Q
HP 7570A Draft Pro Plotter	4895	
Total	12730 each	
for 2 units	25460	

	VENDORS		
SUMMARY OF TOTAL HARDWARE COSTS	**CAD/CAM**	**USL**	
2 Workstations	78048	85550	
Digitizer/Controller	17265	15228	
Plotter	9634	12300	
Printer	1595	1995	
Ethernet	850	850	
Total	107392	115923	
2 Micro Stations Including Digitizers Plotter & Printers	25460	25460	using CAD/CAM price
Total Costs	132852	141383	

For comparison purposes, where one vendor did not quote a component, the price submitted was used for both vendor and note as NQ for the vendor that did not quote.

- SOFTWARE COSTS -

CARIS		28200	per CPU
INGRES		17875	for 2-8 w/s
Micro Software	1000 per CPU		
Total	1000	32325	
Software Maintenance (Annual Costs)		8677	

SUMMARY OF SOFTWARE COST	**PURCHASE PRICE**
2 Workstations and 2 micros	
CARIS	$56400
ingres	19875
MICROS	2000
Total	$76275
Annual Maintenance and Support	8677

TRAINING COSTS FOR CARIS - AS PER USL SCHEDULE

SUBJECT	#DAYS	#PEOPLE	COST @ $150/MB
Intro to Caris	2	12	$3600-
Program Development & Implementation	2	12	3600
System Administration	3	5	2250
User's Perspective	5	12	9000
Application Development	2	12	3600
Database SQL Workshop	3	12	5400
Database Analysis	5	12	9000
Application Development & Design	3	12	5400
TOTAL CARIS TRAINING			$41850

ESTIMATED TRAINING COST FOR SYSTEMS

SUBJECT	#PEOPLE	# DAYS	COST @ $450/DAY
SUN O/S	5	5	2250
TCP/IP & NFS	5	2	900
Systems Operation	5	3	1350
Systems Documentation	3	3	1350
Scheduling	2	3	1350
I.S. Project Management	2	5	900
SYSTEMS TRAINING COST			8100
TOTAL TRAINING COSTS			$49950

NOTE: Estimates based on assumption that courses held a DF & A site and reflect cost of instruction only.

ACQUISITIONS OF DATABASES

155	1:10 000 digital maps @ $100 per sheet	$15500
	GIC Symbol file	1000
	AES Weather Data for 10 years for N.B. sta.	250
	MEDS DATA (Estimated)	7000
	DFO Data - All four regions (Estimated labour charges from DFO)	5000
	Labour charges from others Commerce & Technology, Labour & CHS (estimated)	2000
	TOTAL TO ACQUIRE DB'S	30750

TRANSLATION OF CARIS MANUAL TO FRENCH $110000

- HUMAN RESOURCES -

Excluding the seven possible users shown on Figure 14 (Appendix X-1), 5 GIS trained resources will be required for the project. These are as follows:

GIS manager
Sr. Analyst and D.B. manager
Systems Administration
Cartographer/digitizer operator
Programmer

Their individual responsibilities have been defined in Section 9.0 page 28 of the report. The department can either hire new staff, train existing staff, hire the services of consultants or a combination of these 3 options. Given the current scarcity of GIS resources in North America at this time, it is unlikely that the department would be able to hire all new staff. All the positions described above are **full time commitments** except perhaps for the systems administrator. It is unlikely that existing departmental staff could be given these additional GIS responsibilities (including the training) and still successfully manage their existing responsibilities plus the new GIS responsibilities as well.

Consequently, the following recommendations are presented:

- clone a consultant GIS Manager to a Senior staff person within the department to transfer the necessary, GIS specific skills. The manager needs to successfully manage a GIS site within the department. The skill sets needed include:
  - systems development methodologies
  - systems resource scheduling
  - documentation standards
  - GIS/remote sensing linkages
  - factors effecting GIS input scenarios

- Train the departmental IS coordinator as the systems administrator
- Hire a Sr. Analyst/DB Manager as a permanent staff person
- Re-train existing departmental cartographers to fulfill the cartographer/digitizer operator position.
- Retain a programmer from a consultant

New personnel resourcing costs are therefore estimated as follows:

EXISTING STAFF	
Estimated annual salaries combined	$100,000
NEW HIRES	
Sr. Analyst/DB Manger (estimated annual cost)	50,000
-Outside Consultants- -GIS Manager- 7 months at $6283/month (@ current rate for F. Kolls)	43,984
-Programmer- Estimated use of 8 months at rate for Derek Davidson of ISG/GIS section ($40 per hour)	50,274
TOTAL RESOURCING COSTS FOR 15 MONTHS	
EXISTING OR HIRED STAFF	187,500
Consultants	94,258
TOTAL	$281,758

- PHYSICAL FACILITIES -

Because of the size and type of peripherals associated with GIS sites, special physical facilities are required. The space required for the GIS site as detailed in the report would be approximately 300 square feet. Additionally, heat generated from both the workstations and the digitizers can be a problem. As well, the lighting needs to be variable. Direct sunlight on the graphics screens and digitizer surface must be controllable. However, working in a windowless environment is not necessarily desired from a human perspective.

Based on current rental costs for the department of $18.50 per square foot per year, the annual rental costs for 300 square feet would be:

space rental	$5,550
over the life of the pilot - 15 months	6,938

Additional costs for air conditioning and light control may be incurred.

- PROJECT COST SUMMARY -

The estimated costs for all components over the **15 month** implementation schedule is therefore as follows:

		MINIMUM	MAXIMUM
Hardware Purchase		132,852	141,383
Software Purchase		76,275	76,275
Maintenance -	Hardware	7,500	7,500
	Software	10,845	10,845
Training in	Caris	41,850	41,850
	Systems	8,100	8,100
Database Aquisitions		30,750	30,750
French Translation of Manuals		110,000	110,000
Human Resourcing			
	Departmental Staff	187,500	187,500
	Consultants	94,258	94,250
Physical Facilities		6,938	6,938
TOTAL 15 MONTH COSTS		$706,868	$715,391